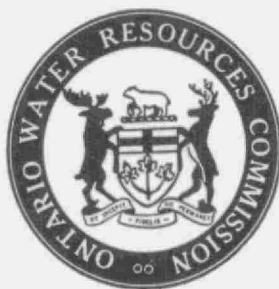


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THE
ONTARIO WATER RESOURCES
COMMISSION

RELIABILITY OF A COMPOSITE SAMPLING TECHNIQUE
FOR ESTIMATING CHARACTERISTICS OF SURFACE WATERS

A Preliminary Report

BY:

DR. A. E. CHRISTIE

December, 1967 .

DIVISION OF RESEARCH

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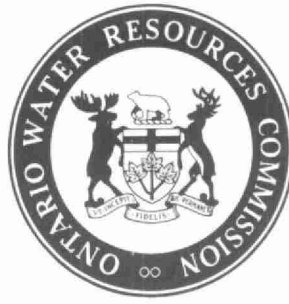
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Reliability of a composite
sampling technique for
estimating characteristics of
surface waters : a preliminary

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RELIABILITY OF A COMPOSITE SAMPLING TECHNIQUE FOR
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A Preliminary Report

by:

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December, 1967

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Reliability of a Composite Sampling Technique for Estimating Characteristics of Surface Waters

During 1967 several locations in the Bay of Quinte region were assayed at regular intervals as part of a primary productivity study (Research Project 67.10) by obtaining four composite water samples at each location. These samples, two for chemical analyses, one for chlorophyll determinations, and one for algal enumeration, were obtained by determining the depth of the photic zone at each station using a submarine photometer and then rapidly passing open 40 ounce bottles through the column of water until filled.

To test the reliability of analyses from these samples as an indication of conditions existing at each location, data obtained from samples obtained by the above method were compared with analyses of samples obtained in June, August, and October using a van Dorn water sampler. These latter samples were acquired by sampling the same column of water as the composite sample, but at discrete depths.

Data of various representative parameters - total solids, pH, alkalinity, hardness (Ca, Mg), total phosphate, ammonia, nitrate, total nitrogen, iron, sulphate, algae - ASU, and chlorophyll a, were then statistically analyzed to determine the homogeneity of the two sampling techniques.

Data presented in Table I provides information concerning the location, time of sampling, depth of column sampled, and the number of depths assayed using the van Dorn.

In Table II the results of various chemical and biological analyses which were used in the statistical analysis are shown, and Table III provides an example of the statistical procedure used.

The homogeneity of the two sampling techniques was tested using the variance ratio or F test - mean square of sampling/mean square of individuals. The results of these various F tests, presented in Table IV along with values obtained for the corresponding degrees of freedom from Table 10:5:3 (Snedecor, 1957)*, show that the composite sampling technique compares favourably with the van Dorn sampling procedure in providing a satisfactory indication of conditions existing at a given station with respect to the parameters utilized in this study.

* Snedecor, G.W. Statistical Methods. The Iowa State College Press Ames 1957.

Table I

The location, date, depth of water sampled,
and number of samples used to compare composite and
van Dorn sampling techniques.

Station	Date	No. of van Dorn Samples	Depth Sampled <u>in Meters</u>
Big Bay	June	4	4
	August	5	4
	October	5	4
Glenora	June	4	4
	August	5	4
	October	5	4
Conway	June	6	16
	August	5	4
	October	5	11
Lake on the Mountain	June	6	20
	August	5	12
	October	5	14

Table II

Data obtained using composite (c) and van Dorn (V) sampling techniques at four stations, at three different times in 1967 in the Bay of Quinte region. V - average value throughout sampling zone.

Station	Sample	Date	Total Solids	pH at lab.	Alkalinity	Hardness Ca, Mg	Total Phosphate	Nitrogen NH ₃	NO ₃	Total	Fe	SO ₄	Algae ASU/ml	Chlorophyll a
Big Bay	V	June	156	8.1	106	-	0.12	0.23	0.07	0.63	-	-	66.88	4.8
	C		166	8.0	107	-	0.09	0.23	0.10	0.65	-	-	114.72	5.2
	V	Aug	150	8.8	96	112	0.24	0.25	0.07	0.95	0.22	19	200.50	13.9
	C		164	8.8	96	111	0.25	0.30	0.08	0.78	0.23	19	272.36	15.8
	V	Oct	137	7.8	92	104	0.11	0.31	0.02	-	0.27	21	446.48	34.0
	C		112	8.2	93	102	0.18	0.30	0.10	-	0.27	21	498.11	34.0
Glenora	V	June	195	8.2	103	-	0.08	0.24	0.10	0.66	-	-	143.73	3.9
	C		230	7.9	104	-	0.08	0.23	0.10	0.65	-	-	534.92	15.6
	V	Aug	165	8.2	100	126	0.24	0.29	0.03	0.85	0.12	23	257.84	7.1
	C		168	8.6	96	129	0.20	0.10	0.00	0.52	0.10	23	108.17	8.0
	V	Oct	174	8.4	93	126	0.21	0.09	0.01	-	0.12	22	306.79	19.1
	C		235	8.4	97	122	0.20	0.20	0.01	-	0.15	22	292.31	22.7
Conway	V	June	188	8.4	100	-	0.07	0.20	0.04	0.60	-	-	131.32	3.5
	C		202	8.4	100	-	0.15	0.16	0.05	0.58	-	-	130.12	3.6
	V	Aug	182	8.2	96	133	0.19	0.30	0.03	0.59	0.12	25	193.47	7.3
	C		218	8.2	96	100	0.31	0.36	0.04	0.39	0.20	25	122.52	2.8
	V	Oct	190	8.3	95	134	0.12	0.09	0.11	-	0.10	29	116.76	23.9
	C		201	8.3	98	150	0.11	0.06	0.15	-	0.08	29	150.07	22.7
Lake on the Mountain	V	June	165	8.0	108	-	0.05	0.30	0.17	0.67	-	-	85.97	3.5
	C		182	8.1	107	-	0.12	0.13	0.20	0.52	-	-	80.69	2.1
	V	Aug	152	8.7	86	116	0.03	0.07	0.00	0.59	0.10	24	76.60	2.1
	C		162	8.4	85	119	0.01	0.02	0.00	0.65	0.10	24	74.94	3.0
	V	Oct	117	8.2	80	105	0.03	0.05	0.00	-	0.04	27	248.64	1.8
	C		112	8.2	80	105	0.04	0.05	0.00	-	0.05	27	230.00	3.0

Table III

Example Statistical Analysis of Data to determine homogeneity of sampling techniques - Total Solids analyses from four stations, at three times by two techniques.

V - van Dorn, C - composite

Time	Technique	Station			
		Big Bay	Glenora	Conway	Lake on the Mountain
June	V	156	195	188	165
	C	166	230	202	182
August	V	150	165	182	152
	C	164	168	218	162
October	V	137	174	190	117
	C	112	235	201	112

Source of Variation	degrees of freedom	Sum of Squares	Mean Square
Station	3	13,703	
Time	2	2,685	
Sampling	1	1,369	1,369
Individuals	<u>17</u>	<u>7,653</u>	450
Total	23	25,410	

$$F_{\text{experimental}} = 1369/450 = 3.04$$

$$F_{\text{table } f_{95} \text{ 1, 17}} = 4.45$$

Table IV

Comparison of Experimentally Determined F values for various sampling parameters with tabular F values (Snedecor 1957)

Parameter	Experimental F value	Tabular F value
Total Solids	3.04	4.45
pH	0.37	4.45
Alkalinity	0.00	4.45
Hardness	0.13	4.96
Total Phosphate	1.09	4.45
Ammonia	0.42	4.45
Nitrate	0.40	4.45
Total Nitrogen	3.45	4.96
Iron	0.39	4.96
Sulphate	0.00	4.96
Algae - ASU	0.36	4.49
Chlorophyll a	0.22	4.49

CONCLUSION

This preliminary report is being released to indicate the significance of a sampling technique used as part of algal productivity studies. In view of the limited staff of the Special Studies Branch, it is imperative that field sampling procedures and concomitant laboratory analyses be kept minimal and yet produce reliable information.

The composite sampling technique, which is shown above to have no detectable difference from the more involved Van Dorn procedure, has proven of great benefit in obtaining a satisfactory estimate of chemical and biological changes occurring at several locations under investigation.